

CMU/SEI-87-TR-16
ESD-TR-87-117



Carnegie-Mellon University
Software Engineering Institute

Preliminary Report on Conducting SEI-Assisted Assessments of Software Engineering Capability

Watts Humphrey

David Kitson

July 1987

ADA183429

Technical Report

CMU/SEI-87-TR-16

ESD-TR-87-117

July 1987

**Preliminary Report on Conducting
SEI-Assisted Assessments of Software
Engineering Capability**



Watts S. Humphrey

David H. Kitson

Software Process Feasibility Project

Approved for public release.
Distribution unlimited.

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, Pennsylvania 15213

This technical report was prepared for the

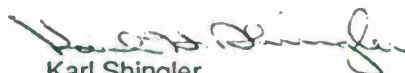
SEI Joint Program Office
ESD/XRS
Hanscom AFB, MA 01731

The ideas and findings in this report should not be construed as an official DoD position. It is published in the interest of scientific and technical information exchange.

Review and Approval

This report has been reviewed and is approved for publication.

FOR THE COMMANDER



Karl Shingler
SEI Joint Program Office

This work was sponsored by the U.S. Department of Defense.

This document is available through the Defense Technical Information Center. DTIC provides access to and transfer of scientific and technical information for DoD personnel, DoD contractors and potential contractors, and other U.S. Government agency personnel and their contractors. To obtain a copy, please contact DTIC directly: Defense Technical Information Center, Attn: FDRA, Cameron Station, Alexandria, VA 22304-6145.

Copies of this document are also available through the National Technical Information Services. For information on ordering, please contact NTIS directly: National Technical Information Services, U.S. Department of Commerce, Springfield, VA 22161.

Table of Contents

1. Introduction	1
1.1. Overview of the Assessment Process	2
1.2. Assessment Principles	3
1.2.1. Confidentiality	3
1.2.2. Senior Management Involvement	3
1.2.3. Non-Adversarial Attitude	3
1.2.4. Action Orientation	4
2. Selecting Candidate Organizations	4
2.1. Generic Criteria	5
2.2. DoD Organization Criteria	5
2.3. Special Considerations for Industrial Assessments	5
3. Preparing For The Assessment	5
3.1. Assessment Team Composition	5
3.2. Assessment Team Training	6
4. Conducting the Assessment	7
4.1. Introductory Presentation	7
4.2. Applying the Assessment Instrument	8
4.3. Functional Areas Interviews	8
4.4. Project Feedback Reviews	8
4.5. Presentation of Findings	9
5. Final Assessment Findings and Recommendations	9
6. Post-Assessment Follow-Up	10
6.1. Action Plans	10
6.2. Periodic Site-Management Review	10
6.3. Process Group Formation	10
6.4. SEI Continuing Support & Guidance	11
6.5. Reassessments	11
Acknowledgment	13
Appendix A: Example Software Engineering Assessment Agreement	15
Appendix B: Example Assessment Training Agenda	19
Appendix C: Example Detailed On-Site Agenda	21
Appendix D: References	27
Appendix E: Bibliography	29

Preliminary Report on Conducting SEI-Assisted Assessments of Software Engineering Capability

Abstract

Characterizing the state of software engineering practice within an organization is a necessary prerequisite to orderly, meaningful, and sustainable improvement of the organization's ability to produce or support cost-effective, high quality software products. The Software Engineering Institute (SEI) is developing a methodology for conducting SEI-assisted assessments of software engineering capability. The assessment methodology has five phases: 1) selecting the candidate organization, 2) preparing for the assessment, 3) conducting the assessment, 4) communicating final assessment findings and action recommendations, and 5) post-assessment follow-up activities. This report describes the methodology in detail.

1. Introduction

Process assessments are used to study software organizations and determine the state of their development and maintenance processes. The intent of assessments is to understand the state of practice of software engineering in the organization, to identify key areas for improvement, and to initiate actions that will lead to improvements. The SEI is developing an assessment instrument that will support characterizing the state of software engineering practice in an organization [1]. Like any tool, however, it must be applied in the proper context and used skillfully. The primary objectives of this report are to provide guidance on creating the proper environment for a meaningful assessment and prescribing effective use of the assessment instrument.

There are several contexts in which software process assessments can be conducted. Among these are:

- Externally-assisted assessments of an organization, such as by the SEI, in which an assessment team conducts in-depth interviews with project teams and formulates a composite profile of the state of practice in the organization. The SEI has performed assessments of this type and is continuing to do so.
- Self-assessments conducted by a project or organization in order to determine its state of software engineering practice. There are a number of disadvantages to conducting self-assessments [2].
- Workshop assessments conducted in conjunction with a conference or other tutorials. This type of assessment can be useful in quickly gathering industry profile data, generating a high volume of feedback on the quality of the assessment instrument, and providing broader awareness of the assessment process and its benefits. The SEI will be conducting assessments of this type.
- Contractor evaluation assessments conducted as part of the DoD procurement process. It is expected that the assessment instrument being developed by the SEI will be used in various phases of the DoD software acquisition process but the SEI will not participate in such assessments.

This report will specifically address SEI-assisted assessments of an organization. The SEI has used its assessment instrument to conduct trial assessments of some 35 projects in ten industrial and government software organizations. Early results indicate that an SEI-developed software process maturity model [3] reasonably characterizes the state of software engineering practice within a software organization and provides a mechanism to rapidly identify the key improvement issues that they face.

This document is intended to serve as a guide for conducting SEI-assisted software process assessments. Although each of the assessment types mentioned above may require slightly different methods, there is much that they have in common. Thus, this document should be helpful to those who are charged with conducting any of the software process assessment types mentioned above. As the SEI gains experience in conducting assessments, this document will be updated to reflect its more complete understanding of how to effectively, efficiently, and accurately characterize the software engineering capability of organizations.

1.1. Overview of the Assessment Process

Software assessments are similar to the organizational development process, which has been used successfully to motivate change in a number of very large organizations [4, 5, 6]. In both organizational development and software assessment, the crucial prerequisite is to gain sufficient rapport with the organization's key people so they will share their problems, concerns, and creative ideas.

SEI-assisted assessments are typically conducted in five phases:

1. During the first phase, an organization is identified as a desirable candidate for assessment. The SEI initiates contact and obtains organizational commitment to the full assessment process. This commitment includes the personal participation of the senior site manager, site representation on the assessment team, and agreement to follow up on recommended actions. An assessment agreement (see Appendix), which includes these and other elements of the joint agreement, is signed by the organization and the SEI.
2. The second phase is devoted to preparing for the on-site assessment. An assessment team is selected and trained, and an assessment plan is formulated.
3. In the third phase, the on-site assessment is conducted. On-site presentations are made to orient site personnel who will be participating in the assessment. The assessment instrument is applied, and the resulting data and information is reviewed and evaluated by the assessment team. The final on-site activity is to present preliminary findings to assessment participants and senior site management.
4. The fourth phase is concerned with formulation and communication of final assessment findings and action recommendations. The assessment team prepares a formal written report which, along with a formal on-site briefing, is presented to the organization.
5. The final phase consists of post-assessment follow-up activities. An action team composed entirely of professionals from the organization is assembled and charged with planning and implementing the recommendations. Typically, there is also some continuing support and guidance by the SEI, as well as a subsequent follow-up assessment to determine the overall results.

1.2. Assessment Principles

There are several critical prerequisites to a successful assessment which must be thoroughly understood and accepted by assessment participants in both the assessed and assessing organizations. This section discusses these principles.

1.2.1. Confidentiality

The first thing to establish in a software assessment is that it is being done for the benefit of the organization. This is both essential and extraordinarily difficult to do. The assessment results must be kept in strict confidence. No leaks can occur, even to the organization's chief executive. While everyone will agree to confidentiality in principle, it is hard to maintain. Senior management has a proper interest in the results; but if the members of the organization learn that they cannot really speak in confidence, trust will be lost that will be nearly impossible to rebuild.

Confidentiality is required at all levels of the organization. All the professionals who talk must be told that what they say will not be attributed to them. Several projects should always be reviewed at the same time and each of the project managers must be told the results for his or her project but no others. Site management, however, must only be given a composite story on the facility. This approach insures that no project or individual is singled out as having unique problems.

1.2.2. Senior Management Involvement

The senior site manager is the person who sets the operational priorities for the organization. This individual must be personally involved in the assessment process and the follow-up actions. This specifically includes attendance at initial and final on-site briefings. He or she sets the basic priorities and must be convinced of the action's importance if anything is to happen. This involves sufficient priority to assign qualified people for the planning and implementation.

Without participation of the senior site manager, the review cannot be successful. The people at lower levels can generally handle the problems during normal or routine operations, but lasting improvement of the software process must necessarily concern the organization's behavior in a crisis. That is when the process is under the most stress, when management is most likely to defer all nonessential activities, and when serious disasters are most likely to occur. Since crises are common in the software business, a process must be able to survive a crisis to be useful.

1.2.3. Non-Adversarial Attitude

The third principle is that the process be non-threatening and focused on learning and understanding. An assessment, by its very nature, is an arrogant activity. A group of remote "experts" plans to review a large, complex organization and in only a few days tell them what they are doing wrong and what they should do to improve. Generally, the local people work hard, are dedicated to doing good work, and have been trying to improve things for years. They may be understandably skeptical of such studies and secretly expect the whole thing to fail.

This attitude is not only understandable, but quite proper. No small team of outside experts can hope to identify the most critical problems in any reasonably large software organization in a short time. Complex problems rarely have simple answers, and the subtleties of most organizations are far too intricate for any group to fathom in a few days.

The tacit assumptions must be that the people are not dumb or misguided and that they have many good ideas. If the assessment team arrives thinking they have all the answers, the local professionals will quickly sense it. Their natural reaction will be to attempt to prove that these "experts" are not so smart after all. This leads to a subtle and unspoken hope that the assessment will fail. Under these conditions it often does.

The power of the assessment process, however, is that it taps the knowledge and creative skills of the best local people. If they can be convinced to contribute, the assessment can be a catalyst to motivate the entire organization to self improvement. But it will only work when it is seen as a help, rather than as a threat.

Any assessment team that comes across as smug or having all the answers will cause immediate resentment. A highly critical attitude or a lack of interest in local views and opinions can be deadly. When good work is found it should be recognized, and mistakes and oversights should be objectively noted. The assessment team must expect that any suggestions they might make will have to be tested and evaluated by the local people to see if they will really work in practice. As hard as it is to achieve, the proper attitude is one of humble but assured professionalism.

Even when the assessment team behaves in a thoroughly circumspect and humble manner, some of the local managers and professionals will resent the assessment activity and not participate fully, no matter how carefully the assessment has been planned and implemented. However, if the team really believes that they cannot be successful without the wholehearted help and support of the on-site professionals, this will be recognized and most of the people will respond.

1.2.4. Action Orientation

Finally, the entire motivation of the assessment must be directed toward improvement. The orientation is action, so the questions must focus on defining those problems that need to be solved right away. If this is not the case, the assessment may make the situation worse. Prior to the assessment, the local professionals are generally aware of the worst problems but assumed management is not. While this leads them to view management as somewhat inept, they could always assume that management really didn't understand the issues and so couldn't be expected to address them. After the assessment, this is clearly no longer the case. A structured study by a team of experts has listened to some of the most competent professionals in the organization describe the state of practice and what should be done about it. This is then personally reported to the senior management in a written report, together with a set of recommendations. Any management that does not then take action must be seen as either incompetent or distracted by other, more important issues. In either case, the morale of the software professionals is bound to suffer. Hence, either be prepared to take action or don't assess.

2. Selecting Candidate Organizations

Listed below are criteria to be considered during the process of selecting an organization for software assessment. While it is impossible to formulate rules that apply in every case, these guidelines can be helpful in making reasonable selection decisions.

2.1. Generic Criteria

Criteria for selecting an organization for assessment depend on the objectives of the assessment initiator. In the case of the SEI, the goal is to demonstrate the feasibility and value of the assessment approach to improving the software process in the DoD community. Thus, an organization should have the following attributes:

1. The organization has software of sufficient significance to warrant special attention.
2. The senior site manager agrees to personally participate by being present for the opening on-site assessment briefing and the on-site review of final findings and recommendations; the manager also agrees to develop appropriate action plans in response to the assessment recommendations.
3. The organization's management is willing to sign an assessment agreement (see Appendix).
4. Data from the assessment will be of value to the SEI.

2.2. DoD Organization Criteria

In keeping with its mission, the SEI balances its efforts among the Services and considers DoD priorities and needs in selecting candidates for assessment.

2.3. Special Considerations for Industrial Assessments

The following criteria are intended to guide the SEI selection of industry participants in the assessment activity.

1. The SEI will avoid participating in assessments of projects that are engaged in a competitive phase of a procurement.
2. If all criteria are equally satisfied by more than one contractor (that is, if we have multiple acceptable invitations) the order of the assessments to be undertaken will be determined considering the order in which the invitations were received, the relative value of the assessment to the National interest and to the SEI, and the level of prior joint activity between the SEI and the organization.

3. Preparing For The Assessment

A successful assessment requires careful and detailed preparation and training. This section discusses pre-site visit activities that are intended to set the stage for a smooth and orderly on-site assessment.

3.1. Assessment Team Composition

Once the organization has agreed to an assessment, the assessment team must be selected and trained. The members should be experienced software developers and, wherever possible, at least one member should have had experience in each phase of the software development and maintenance process. Three to five professionals are typically adequate, although more may be used if desired. A team with more than ten members can be expensive, intimidating to participants, or hard to manage. The SEI team leader must have had prior assessment experience and be familiar with the software development and maintenance process. All the team members, however, should be capable of making presentations and gathering information in a non-threatening manner.

At least one member from the organization being assessed should participate as a full member of the team. This facilitates the planning process, provides a means for the team to learn about the organization, and establishes a focal point for later action. Since the local member is so crucial to the success of the entire effort, the senior site manager should personally make the selection.

3.2. Assessment Team Training

The entire assessment team should participate in a brief training program. This is not only to familiarize them with the assessment activity but also to build a coherent team. The site member(s) must participate in the training and help to develop the plan for the on-site assessment. A site member must also be designated as the coordinator for the on-site arrangements. Typically, two or three days will be required for training, and the team leader will conduct the training.

In addition, the team members must agree to dedicated participation during the training period, the on-site review, and the wrap up meetings. This means that phone calls will be held, all meetings and other commitments rescheduled, and the members will be on time to every session.

The assessment team training consists of the following sessions (see appendix for an example training agenda):

1. SEI Overview — The first training session is devoted to an overview of the SEI. This is done to familiarize the site representative(s) with the role of the SEI within the field of software engineering. The major program areas are briefly identified and reviewed.
2. Process Management Overview — The foundational material dealing with process management is introduced in this session [3]. The process management premise and the principles of process management are discussed. The process management maturity level model [3] is presented and used, along with the idea of technology stages, to provide the basis for the process technology matrix [1]. The significance of the various regions in the process technology matrix is explained. Finally, these concepts and models are used to characterize the improvement process.
3. Site Overview — It is important for the SEI members of the assessment team to understand the mission and function of the site to be assessed. This session is devoted to a discussion of the organization which will be assessed. This presentation is given by the senior site assessment team member.
4. Assessment Introduction and Guidelines — This training session is spent in an overview of the assessment process. The guidelines for assessment are discussed, use of the assessment instrument is explained, the role of supporting materials is discussed, and assessment evaluation is explained.
5. Assessment Questionnaire Review — The assessment is based on responses to the assessment instrument. Therefore, it is important for all assessment team members to fully understand the spirit and intent of all questions. Thus, this session is devoted to a detailed review of each question. A simulated assessment is conducted based on previous experiences of team members.
6. Supporting Materials Discussion — It is important to be able to verify the accuracy of the responses to the SEI questionnaire. This is achieved through the requests

for supporting materials which serve to validate responses to the questionnaire. During this session, the process for identifying areas for further investigation is reviewed and particular questions are identified based on assessment responses.

7. **Assessment Evaluation and Findings** — This session is devoted to a discussion of the techniques to be used in determining both project and composite maturity levels and technology levels [1, 3]. The data from the simulated assessment is used as the basis for evaluation and preliminary findings.
8. **Conclusions and Recommendations** — The general approach to formulating conclusions and recommendations from the assessment evaluation and findings is discussed in this session.
9. **Planning for Site Visit** — Details of the plan for the site visit are discussed. The plan for the on-site assessment itself should include the identification of the specific projects to be examined, the people to be interviewed, and the facilities required. Since the people and facilities in most software organizations are heavily committed, significant advance notice is generally required.

Typically, three to five projects are selected as representative of the process used at the location. Multiple projects are studied both to assure reasonable coverage of the work at the location and to permit presentation of composite findings in the final report without violating the confidentiality principle.

Improper seating can send subtle and erroneous messages to the interviewees. A conscious effort should be made to avoid configurations of tables and chairs which seem to put the assessment team in a superior role. Try to arrange for an informal seating arrangement and mix the assessment team members with the site personnel.

Daily agendas of the visit should be discussed and agreed upon (See Appendix for an example on-site agenda).

4. Conducting the Assessment

This section discusses the sequence of activities that constitute the on-site portion of the assessment. Typically, these activities require about four days to complete.

4.1. Introductory Presentation

The assessment starts with a presentation to the senior site manager, his or her immediate staff, the managers of the selected projects, as well as senior software professionals from these and other projects who are most knowledgeable on particular facets of the development and maintenance process. The presentation opens with a brief statement of the agenda and an introduction of the assessment team members. Next, the assessment agreement is reviewed, including a description of how the assessment will be conducted and the schedule for the assessment and following activities. Any questions or concerns are addressed, and copies of the assessment agreement and schedules are distributed.

4.2. Applying the Assessment Instrument

Following the introductory presentation, the assessment team, project managers, and technical participants meet in a joint session devoted to a more detailed discussion of the assessment process. This is followed by an interactive period devoted to formulating initial responses to the questions in the assessment instrument. Project managers mark their copies of the assessment instrument, and the assessment team provides clarification on questions as necessary.

Following this joint session, the assessment team meets in a closed session during which an initial determination of the maturity level of the projects and organization is made. Also, areas where supporting materials are appropriate are identified.

Next, the assessment team meets with the project representatives on a project-by-project basis to ask additional questions in the areas previously identified and, where appropriate, to request specific supporting materials.

As a final activity for this stage, the assessment team holds a private wrap-up meeting to review the progress of the assessment and to prepare for the next stage.

4.3. Functional Areas Interviews

Next, interviews are conducted with project personnel from each major functional area of the organization's software process. Approximately six separate interview sessions are held with the format varying between 45 minute sessions with an individual and 90 minute sessions with small groups. The entire assessment team is present for these interviews. The purpose of the interview sessions is to determine the actual details of the software process since the assessment questionnaire only provides an overview of the process. Each individual to be interviewed is told they may bring 1 or 2 foils if they wish, but that it is to be an informal session during which they will be asked to describe how they do their work. Where possible, they should bring some typical work products to demonstrate the methods they use. Near the end of the interview, a key question should be asked: "If there was one thing you could do to improve the quality or productivity of your work, what would it be?" The answers to this question are very important because experience shows that the people working on the project generally know better than anyone what needs to be done to improve it.

As the final item, the assessment team holds a closed wrap-up meeting to review the day's findings and prepare for the next stage.

4.4. Project Feedback Reviews

The assessment team meets with project representatives separately to review the supporting materials of each project. At this time, the assessment team will verbally review its findings for the project and the composite results for the organization and allow the project representatives to comment on them.

Ad hoc discussions with various groups may occur following the individual project reviews. The intent here is to gather additional data to support the findings and to identify any other problem areas.

At the conclusion of this stage, the assessment team should have achieved consensus on the final findings for presentation at a joint meeting on the last day of the assessment.

4.5. Presentation of Findings

This stage is devoted to preparation and presentation of individual project and composite organization findings. The assessment team meets privately to review their conclusions, make changes they deem warranted based on review of the supporting materials, decide on the key recommendations to be made, and prepare the report for presentation at the final management meeting. Some key items to consider for the final presentation are:

1. The cooperation and support of the participants should be acknowledged, and any unusually good or innovative work should be identified (by name wherever appropriate).
2. Only the composite conclusions of the assessment are presented, so no project is uniquely identified with any problem.

5. Final Assessment Findings and Recommendations

Following the on-site assessment visit, the assessment team prepares a draft final report of the assessment findings and recommendations. The recommendations should be limited to at most ten items, with the four or five most urgent highlighted for immediate attention. No organization can handle more than a few high priority tasks at one time, so the items requiring the most urgent attention should be clearly spelled out. The organization's assessment team members then visit the SEI for the purpose of reviewing the draft report. Once consensus within the assessment team has been achieved, the next on-site action is the presentation of the final report to the senior site manager and staff. This typically occurs about a month after the completion of the on-site portion of the assessment.

The final report should contain the following information:

1. Summary and Conclusion — an executive level summary of the assessment team's findings.
2. Software Assessment — a brief description of the context of the assessment and a chronology of key events.
3. Site Status — in terms of composite maturity level and technology state.
4. Key Findings — the most important findings.
5. Recommendations — the assessment team's recommendations.
6. Assessment Agreement — a copy of the signed assessment agreement included as an appendix.

6. Post-Assessment Follow-Up

Although, strictly speaking, the goal of an assessment is to accurately characterize the current state of software engineering practice in the organization and identify key next steps for improvement, the ultimate intent is to be the catalyst for improvement in the assessed organization. This section focuses on activities that take place after the assessment and which can be effective in increasing the likelihood that improvements will occur.

6.1. Action Plans

Following the on-site presentation of final findings and action recommendations, action plans are prepared by the assessed organization, generally under the guidance of the site assessment team member who was named for this purpose by the senior site manager. If properly chosen, he or she is now fully knowledgeable of the issues to be addressed and known and respected by the people who must be involved. It is generally wise to involve leading professionals from the various projects in this work. This not only helps to produce a quality result but it also facilitates its ultimate acceptance.

The action plans should focus on the sub-goals identified for periodic management review (see Section 6.2). Only one or two action plans should be attempted at a time, and special attention should be devoted to ensuring early small successes that will pave the way for larger successes as the effort builds momentum via acceptance and participation within the organization.

A timetable for staffing the action plan team and developing the action plan should be completed within 2 to 3 weeks of the on-site presentation of the final assessment report. Periodic and frequent (e.g., weekly) senior management updates should occur until the action plan team is fully staffed and functioning. This safeguard ensures that the proper priority is given to the important job of formulating concrete improvement plans.

6.2. Periodic Site-Management Review

One of the risks with assessments is that, after they are completed, a few superficial or ineffective efforts will be made to initiate improvement and then everything will revert back to business as usual. Some catalyst is required to maintain focus on the improvement process. One highly effective means is periodic management review. This can be done by establishing a clear set of goals to be achieved by the time of the second assessment and then defining sub-goals to be reached in each of the intervening quarters. Quarterly reviews are then scheduled with senior management with the objectives defined in advance. This will not only help to crystalize the plan but will also serve to create those periodic crises which are required to maintain priority and focus.

6.3. Process Group Formation

It is expected that some resources will be required to manage the continuing improvement of the organization's software process. Software engineering process groups provide a center of expertise to assist the software practitioners, to act as a focal point for improvement, and to serve as the vehicle for organizational learning. A small but dedicated group of very competent and experienced professionals is needed. Typically 1.5% to 4% of the organization is adequate.

A software process group typically concerns itself with the following aspects of the software process:

- defining and documenting the software development process,
- establishing critical process measures,
- planning for new tools and technologies,
- conducting quarterly process reviews for senior management.
- assisting the projects in applying improved methods and practices.

Additional areas of activity may be appropriate, but they will depend on the specific findings and recommendations of the assessment team.

6.4. SEI Continuing Support & Guidance

Typically, the SEI will be willing and able to provide post-assessment support and guidance to an assessed organization. The extent and nature of this involvement will be determined on an individual basis.

6.5. Reassessments

Organizations should generally plan to conduct a follow-up Reassessment about a year or so after the action plans have been developed and approved. This is important for several reasons:

- to assess the progress that has been made,
- to establish a target for completion of the most important actions,
- to establish new priorities for continued improvement.

Acknowledgment

The authors would like to thank the members of SEI's Software Process Program who contributed their time as reviewers. Special thanks are due to Bill Sweet and Ed Terreri for their contributions to the assessment agreement, and to Robert Veltre for the training and on-site agendas.

Appendix A: Example Software Engineering Assessment Agreement

Software Engineering Assessment Agreement

This Agreement is entered into by and between the Software Engineering Institute (SEI) and _____ (hereinafter referred to as Affiliate) with its principal office located at _____. This Agreement will be effective when executed by both parties. Its duration will be limited by the nature and scope of the undertakings set forth in the Agreement. Certain commitments will survive completion of the basic tasks set forth.

The SEI is a Federally Funded Research and Development Center (FFRDC) owned and operated by Carnegie Mellon University pursuant to contract with the Department of Defense (DoD). Included in the SEI Charter is a requirement that the SEI shall establish standards of excellence for software engineering practice. In furtherance of that requirement, the SEI is conducting assessments of software engineering practice with individual companies and studying industry-wide practices of software engineering (the Assessment Program). Affiliate has a vested interest in assessing its level of software engineering practice on both an absolute and comparative basis.

Therefore the parties hereto agree as follows:

1. Affiliate agrees to participate with the SEI in an assessment of the Affiliate's software engineering practices.
2. The specific results of the Affiliate assessment shall be proprietary to Affiliate to be used by Affiliate as it chooses (with appropriate credit to the SEI) subject to the right of the SEI to use such results as hereinafter described.
3. Confidentiality is essential to the success of the SEI Assessment Program. The SEI will not identify organizations participating in the Assessment Program.
4. The SEI is free to use assessment data and conclusions to be derived therefrom for statistical, analytical or reporting purposes provided that the confidentiality requirement can be honored and that the information can be used without attribution to its source either directly or by inference.
5. The SEI will not publish collective data externally unless such data is based upon assessments from not less than 10 different organizations.
6. The senior manager of the segment of Affiliate to be assessed will actively participate in the assessment by agreeing to be present (on mutually acceptable dates) for the opening on-site assessment briefing and the on-site review of final findings and recommendations. This level of participation is critical to the success of the project.
7. The SEI will provide four to six professionals as assessment team members.
8. The Affiliate will provide one or two professionals as assessment team members. It is expected that one of these professionals will, in addition, be assigned the following responsibilities:
 - a. participate in a one or two day working session at the SEI shortly following the on-site assessment period to prepare the final assessment report.
 - b. develop the organization's action plan based upon the final assessment report.

9. There will be two days of pReassessment training at the SEI for the entire assessment team.
10. The assessment by the SEI/Affiliate team at the Affiliate site will be done in three or four days.
11. Typically, three to five projects will be reviewed during the on-site assessment period. The Affiliate will ensure that none of the projects selected for review is involved in a competitive phase of a procurement during the on-site assessment period.
12. The SEI as soon as practicable thereafter will provide to Affiliate a final assessment report which will include recommended actions. The SEI does not represent any U.S. Government procurement agency; therefore, the recommendations made by the SEI are not to be construed as contractual directions or constructive changes to contracts which may exist between the affiliate and the U.S. Government.
13. The Affiliate will within 60 days thereafter provide a review for the SEI of its action plan based on the final assessment report. The Affiliate is the sole determinant as to the extent that recommended actions are implemented through its action plan. It is expected that the review will cover the reasons for rejection of any final assessment report recommended actions not incorporated into the action plan.
14. The SEI, at its option, and with the consent of the Affiliate, may continue periodic interaction with the Affiliate during implementation of the action plan.
15. Each participating organization will be responsible for its personnel and their expenses. Each will provide to the other reasonable working space and support services for assessment team activities.
16. If Affiliate discloses identified proprietary information to the SEI, such information should be disclosed pursuant to a separate nondisclosure agreement. The execution of such agreement notwithstanding, the parties agree to respect the confidential nature of this Agreement and all exchanges of information hereunder. All confidential and proprietary information shall be treated with at least the degree of care with which each party treats its own such information.
17. When Affiliate has received an assessment report from the SEI and has in turn reviewed its action plan with the SEI, the basic assessment tasks will be complete and this Agreement will have served its primary purpose. However, any commitments which by their nature are intended to survive termination of the Agreement (such as nondisclosure) will survive.
18. This agreement shall not constitute, create, give effect to, or otherwise imply a joint venture, partnership or formal business organization of any kind. Each party to this Agreement shall act as an independent contractor and not as an agent for the other, and neither party shall have any authority to bind the other except to the extent, if any, specifically provided herein or by other written mutual agreement of the parties.

Software Engineering Institute

By _____
Date _____

Affiliate

By _____
Date _____

Appendix B: Example Assessment Training Agenda

Agenda Overview

- Software Engineering Institute Overview
- Process Management Overview
- Site Overview
- Assessment Process Overview and Guidelines
- Assessment Questionnaire Review
- Supporting Materials Discussion
- Assessment Evaluation and Findings
- Conclusions and Recommendations

Day 1 Agenda

9:00- 9:15 am	Introductions
9:15- 9:30 am	SEI Overview
9:30-10:15 am	Process Management Overview
10:15-10:30 am	Break
10:30-11:30 am	Site Overview
11:30-12:15 pm	Assessment Process Overview and Guidelines
12:15-1:00 pm	Lunch
1:00- 3:00 pm	Questionnaire Review
3:00- 3:15 pm	Break
3:15- 5:00 pm	Supporting Materials Discussion
5:00 pm	Adjourn

Day 2 Agenda

9:00-10:15 am	Assessment Evaluation and Findings
10:15-10:30 am	Break
10:30-11:30 am	Conclusions and Recommendations
11:30-12:30 pm	Lunch
12:30- 2:30 pm	Planning for On-Site Visit
2:30- 3:00 pm	Review of Training Session Operation and Effectiveness
3:00 pm	Adjourn

Appendix C: Example Detailed On-Site Agenda

First Day Activities

Purpose: Kick off the assessment, administer the questionnaire. By the end of the day, we should be able to request supporting materials and know approximately where the organization stands.

8:00 am - 9:15 am Introductory Management Meeting

Attendees: Senior Site Manager
Senior Management Team
Project Managers and Technical Participants
Assessment Team

Presentation Materials:

1. Introductions
2. SEI Overview
3. Process Management Overview
4. Assessment Agreement
5. Detailed Agenda

Facilities: Large conference room, overhead projector, whiteboard, markers and erasers

9:15 am - 9:30 am Break

9:30 am - 12:00 noon Assessment Overview and Questionnaire

Attendees: Project Managers and Technical Participants
Assessment Team

Presentation Materials:

1. Assessment Process Overview
2. Questionnaire

Facilities: Large conference room, overhead projector, whiteboard, markers and erasers, questionnaire recording forms, extra pens or pencils with erasers

12:00 noon - 1:00 pm Lunch

1:00 pm - 2:30 pm Closed Session

Attendees: Assessment Team

Objectives:

1. Go through the process of determining the maturity level of the organization by examining the level 2 and 3 asterisked questions for each project and for the organization as a whole.
2. Determine where probing is appropriate for supporting materials from the various projects.

Facilities: Private meeting room, forms for recording level 2 and 3 asterisked questions for each project and summarily, reproduction facilities, whiteboard and markers

2:30 pm - 2:45 pm Break

2:45 pm - 4:45 pm Supporting Materials Discussion

Attendees: Project Managers and Technical Participants
Assessment Team

Objectives:

1. Spend 20 minutes per project poking at "issue" areas
2. Where appropriate, request specific supporting materials to be provided on day 3.

Facilities: Conference room, whiteboard and markers

4:45 pm - 5:00 pm Break

5:00 pm - 6:30 pm First Day Wrap-Up Meeting

Attendees: Assessment Team

Objectives:

1. Discuss how the assessment is proceeding.
2. Identify and clarify what the real issues are.

Facilities: Private meeting room, whiteboard and markers

Second Day Activities

Purpose: The second day activities serve as a reality check. While the participants from the first day are given an opportunity to collect the requested support materials, the assessment team meets with other groups to learn the views and practices at some of the leading professionals in the organization and to see if any significant discrepancies exist between actual practice and the questionnaire responses. The assessment team will hold five separate informal technical discussions, each with 3-5 technical professionals with expertise in the particular area being discussed. It should be emphasized that no managers should be present during any of these meetings. The professionals selected to participate should have the following characteristics:

1. Knowledgeable in the area being discussed
2. Respected in the organization
3. Non-managerial
4. Willing to speak their minds
5. Not necessarily from one of the projects being assessed

Each participant should be selected in advance, and should be given a set of guidelines in advance which contain the following information:

1. Summary of why the discussions are being held
2. Rules for the discussions
3. Emphasis on confidentiality

7:30 am - 9:15 am Quality Assurance and Release

9:15 am - 11:00 am System Test and Integration

11:00 am - 12:00 noon Lunch

12:00 noon - 1:45 pm Software Development

1:45 pm - 3:30 pm Software Design

3:30 pm - 5:15 pm Systems Engineering

5:15 pm - 5:30 pm Break

5:30 pm - 7:00 pm Second Day Wrap-up Meeting

Attendees: Assessment Team

Objectives:

1. Compare what was learned today with questionnaire responses, and determine whether or not they support one another.
2. Establish a clear focus for further in-depth examination.

Facilities: Private meeting room, whiteboard and markers, reproduction facilities

Third Day Activities

Purpose: Hold reviews with each assessed project to look at requested support materials, verbally state our findings, and allow the project leaders to give us feedback or refute our findings.

7:30 am - 9:00 am Feedback Reviews

Attendees: Project Managers (individually)
Assessment Team

Objectives:

1. Spend 45 minutes per project doing the things outlined in the purpose for the day.

Facilities: Small conference or meeting room, whiteboard and markers

9:00 am - 9:15 am Break

9:15 am - 10:45 am Feedback Reviews (continued)

10:45 am - 11:00 am Break

11:00 am - 12:30 pm Feedback Reviews (continued)

12:30 pm - 12:45 pm Make Ad Hoc Arrangements

Objectives:

1. Place phone calls to inform various groups of our intent to talk with them about their operation later in the afternoon.

Facilities: Telephones, telephone directory

12:45 pm - 1:45 pm Lunch

1:45 pm - 3:15 pm Ad Hoc Discussions

Objectives:

1. Conduct meetings as necessary to prepare for formulation of final findings.

Facilities: No special requirements

3:15 pm - 3:30 pm Break

3:30 pm - no later than 8:00 pm Third Day Wrap-up Meeting

Attendees: Assessment Team

Objectives:

1. Put together our final findings which will be presented at the final management meeting on the fourth day.

Facilities: Private meeting room, word processor or workstation, printing facilities, slide-making and reproduction facilities

Fourth Day Activities

Purpose: Work on individual project feedback, give composite feedback to project managers, work on outline of final report, and give composite feedback to senior management.

7:30 am - 9:00 am Closed Session

Attendees: Assessment Team

Objectives:

1. Prepare individual project feedback which the site assessment team member can then discuss with the individual project managers after the conclusion of the assessment.

Facilities: Private meeting room, reproduction facilities

9:00 am - 10:30 am Composite Feedback

Attendees: Project Managers
Assessment Team

Objectives:

1. Present the composite status of the organization to the project managers. Should be able to use the same set of slides which will be presented to senior management later.

Facilities: Small conference room

10:30 am - 12:30 pm Closed Session

Attendees: Assessment Team

Objectives:

1. Prepare an outline of the final report by developing a set of action recommendations. This material will not be presented at this time, but will be expanded on later to form the final report to the organization.

Facilities: Private meeting room, whiteboard and markers, reproduction facilities, overhead projector

12:30 pm - 1:00 pm Lunch

1:00 pm - 2:30 pm Final Management Meeting

Attendees: Senior Site Manager
Senior Management Team
Assessment Team

Objectives:

1. Present the findings which have been made over the past three days. Brief management on the next steps.

Facilities: Large conference room, overhead projector

Appendix D: References

1. Humphrey, W.S., Sweet, B. et. al., *A Method for Assessing the Software Engineering Capability of Contractors*, Software Engineering Institute, working draft, 1987.
2. Humphrey, W.S., *Managing for Innovation: Leading Technical People*, Prentice-Hall, 1986.
3. Humphrey, W.S., *Characterizing the Software Process: A Maturity Framework*, Software Engineering Institute milestone report (SEI-87-MR-7), April 1987.
4. Conference Report No. 605, *Organizational Development: A Reconnaissance*, New York: 1973.
5. Huse, E.H., *Organizational Development and Change*. St. Paul, MN: West Publishing Company, 1975.
6. Rodgers, D., *Can Business Management Save The Cities*. New York: MacMillan Publishing Co., Inc., Free Press, 1978.

Appendix E: Bibliography

Bernstein, L., *Software Project Management Audits*, J. Sys. and Software, Vol. 2, pp. 281-287, 1981.

This paper shows how project audits can be used to uncover project strengths and weaknesses. Three audits are described and findings of the audit teams are summarized. Audits helped identify organizational problems, lacking management discipline, and software testing approaches useful to other projects. The issue of product sales versus disciplined project management was faced in all three audits. How this issue was handled is discussed and related to the success or lack of it for each project.

Fagan, M.E., *Design and code inspections to reduce errors in program development*, IBM Sys. Journal, Vol. 15, pp. 219-248, 1976.

Substantial net improvements in programming quality and productivity have been obtained through the use of formal inspections of design and of code. Improvements are made possible by a systematic and efficient design and code verification process, with well-defined roles for inspection participants. The manner in which inspection data is categorized and made suitable for process analysis is an important factor in attaining the improvements. It is shown that by using inspection results, a mechanism for initial error reduction followed by ever-improving error rates can be achieved.

Fagan, M.E., *Advances in Software Inspections*, IEEE Trans. on Software Engineering, Vol. SE-12, pp. 744-751, 1986.

This paper presents new studies and experiences that enhance the use of the inspection process and improve its contribution to development of defect-free software on time and at lower costs. Examples of benefits are cited followed by descriptions of the process and some methods of obtaining the enhanced results.

Software inspection is a method of static testing to verify that software meets its requirements. It engages the developers and others in a formal process of investigation that usually detects more defects in the product — and at lower cost — than does machine testing. Users of the method report very significant improvements in quality that are accompanied by lower development costs and greatly reduce maintenance effort. Excellent results have been obtained by small and large organizations in all aspects of new development as well as in maintenance. There is some evidence that developers who participate in the inspection of their own product actually create fewer defects in future work. Because inspections formalize the development process, productivity and quality enhancing tools can be adopted more easily and rapidly.

Humphrey, W.S., *Programming Process Management*, IBM Tech. Rept. 00.3320, 1984.

This paper outlines the concepts of programming process management, why they are appropriate to programming development, and the general steps to follow in their application. This management overview is to introduce the principles of process management and to provide the rationale

for its adoption by programming management. In the interests of clarity, it is restricted to a management overview. Separate process architecture papers will follow.

The definition of programming quality used here is focused on defects. Because of the impact of programming defects on customer and IBM costs, this discussion concentrates on reducing these defects by improving the management of the development process. This view must broaden in the future to encompass all pertinent aspects of product quality, as seen by the customer.

A practical reference to the principles and methods for managing creative professional people, together with specific guidelines and examples on how these principles can be successfully applied. Includes references to practical experiences on how to build management styles and assess organizations. Topics include: motivating technical and professional people; process management; technical assessment; providing technical leadership; the nature of professional organizations; the identification and development of talented people; innovation; and innovative teams.

Humphrey, W.S., *Software Quality Through Process Management*, National Joint Conference on Developing Quality software, October 8, 1986.

Radice, R.A., N.K. Roth, A. C. O'Hara, Jr., and W. A. Ciarfella, *A Programming Process Architecture*, IBM Systems Journal, Vol. 24, pp. 79-90, 1985.

The Programming Process Architecture is a framework describing required activities for an operational process that can be used to develop system or application software. The architecture includes process management tasks, mechanisms for analysis and development of the process, and product quality reviews during the various stages of the development cycle. It requires explicit entry criteria, validation and exit criteria for each task in the process, which combined form the "essence" of the architecture. The architecture describes requirements for a process needing no new invention, but rather using the best proven methodologies, techniques, and tools available today. This paper describes the Programming Process Architecture and its use, emphasizing the reasons for its development.

Radice, R.A., J.T. Harding, P.E. Munnis and R.W. Phillips, *A Programming Process Study*, IBM Systems Journal, Vol. 24, pp. 91-101, 1985.

A programming Site Study group was convened to look at the work of eight large-system programming development locations within IBM and to evaluate them according to a set of process stages. Eleven attributes were applied to each process stage. The process of the Site Studies is directly transferable to software evaluations on any product in the software industry, and it is believed that the studies are the first step necessary in the evolution of a consistently repeatable and dynamically controllable process of improvement within the industry. The phases of these studies and implementation of the studies are described.

TROY, R. and C. Baluteau, *Assessment of Software Quality for the AIRBUS A-310 Automatic Pilot*, Paper presented at the 15th Annual International Symposium on Fault Tolerant Software, 1985.

As for the whole of the Automatic Flight Control System, the automatic pilot for the AIRBUS is a computer system with high criticality. In order to assess the quality of the software, a number of observations and measurements have been performed during the development cycle. This paper presents a general method of evaluation, the data collected, and some evaluation results.

Weinberg, G. M. and D. P. Freedman, *Reviews, Walkthroughs, and Inspections*, IEEE Trans. on Software Engineering, Vol. SE-10, pp. 68-72, 1984.

Formal technical reviews supply the quality measurement to the "cost effectiveness" equation in a project management system. There are several unique formal technical review procedures, each applicable to particular types of technical material and to the particular mix of the Review Committee. All formal technical reviews produce reports on the overall quality for project management, and specific technical information for the producers. These reports also serve as an historic account of the systems development process. Historic origins and future trends of formal and informal technical reviews are discussed.

UNCLASSIFIED, UNLIMITED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNLIMITED, UNCLASSIFIED			1b. RESTRICTIVE MARKINGS NONE													
2a. SECURITY CLASSIFICATION AUTHORITY N/A			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for Public Release; Distribution Unlimited													
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A																
4. PERFORMING ORGANIZATION REPORT NUMBER(S) CMU/SEI-87-TR-16			5. MONITORING ORGANIZATION REPORT NUMBER(S) ESD-TR-87-117													
6a. NAME OF PERFORMING ORGANIZATION SOFTWARE ENGINEERING INST.		6b. OFFICE SYMBOL (If applicable) SEI	7a. NAME OF MONITORING ORGANIZATION SEI JPO													
6c. ADDRESS (City, State and ZIP Code) CARENGIE-MELLON UNIVERSITY PITTSBURGH, PA 15213			7b. ADDRESS (City, State and ZIP Code) ESD/XRS1 HANSCOM AIR FORCE BASE HANSCOM, MA 01731													
8a. NAME OF FUNDING/SPONSORING ORGANIZATION SEI JPO		8b. OFFICE SYMBOL (If applicable) ESD/XRS1	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F19628 85 0003													
8c. ADDRESS (City, State and ZIP Code) CARNEGIE-MELLON UNIVERSITY PITTSBURGH, PA 15213			10. SOURCE OF FUNDING NOS. <table border="1"><tr><td>PROGRAM ELEMENT NO. 63752F</td><td>PROJECT NO. N/A</td><td>TASK NO. N/A</td><td>WORK UNIT NO. N/A</td></tr></table>		PROGRAM ELEMENT NO. 63752F	PROJECT NO. N/A	TASK NO. N/A	WORK UNIT NO. N/A								
PROGRAM ELEMENT NO. 63752F	PROJECT NO. N/A	TASK NO. N/A	WORK UNIT NO. N/A													
11. TITLE (Include Security Classification) PRELIMINARY REPORT ON CONDUCTING SEI-ASSISTED ASSESSMENTS OF SOFTWARE ENGINEERING CAPABILITY																
12. PERSONAL AUTHOR(S) WATTS HUMPHREY AND DAVID KITSON																
13a. TYPE OF REPORT FINAL		13b. TIME COVERED FROM ... TO ...	14. DATE OF REPORT (Yr., Mo., Day) JULY 87													
15. PAGE COUNT 34																
16. SUPPLEMENTARY NOTATION N/A																
17. COSATI CODES <table border="1"><tr><td>FIELD</td><td>GROUP</td><td>SUB. GR.</td></tr><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>			FIELD	GROUP	SUB. GR.										18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB. GR.														
19. ABSTRACT (Continue on reverse if necessary and identify by block number) CHARACTERIZING THE STATE OF SOFTWARE ENGINEERING PRACTICE WITHIN AN ORGANIZATION IS A NECESSARY PREREQUISITE TO ORDERLY, MEANINGFUL, AND SUSTAINABLE IMPROVEMENT OF THE ORGANIZATION'S ABILITY TO PRODUCE OR SUPPORT COST-EFFECTIVE, HIGH QUALITY SOFTWARE PRODUCTS. THE SOFTWARE ENGINEERING INSTITUTE (SEI) IS DEVELOPING A METHODOLOGY FOR CONDUCTING SEI-ASSISTED ASSESSMENTS OF SOFTWARE ENGINEERING CAPABILITY. THE ASSESSMENT METHODOLOGY HAS FIVE PHASES: 1) SELECTING THE CANDIDATE ORGANIZATION, 2) PREPARING FOR THE ASSESSMENT, 3) CONDUCTING THE ASSESSMENT, 4) COMMUNICATING FINAL ASSESSMENT FINDINGS AND ACTION RECOMMENDATIONS, AND 5) POST-ASSESSMENT FOLLOWUP ACTIVITIES. THIS REPORT DESCRIBES THE METHODOLOGY IN DETAIL.																
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input checked="" type="checkbox"/> DTIC USERS <input checked="" type="checkbox"/>			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED, UNLIMITED, DTIC, NTIS													
22a. NAME OF RESPONSIBLE INDIVIDUAL KARL H. SHINGLER			22b. TELEPHONE NUMBER (Include Area Code) 412 268-7630	22c. OFFICE SYMBOL SEI JPO												

2100 0100 0000 0000

